Uplift – Vise Top Insulators

Abstract

Conductors are secured in the top or neck of the vise top insulator. Gravity and the weight of the cable typical apply downward forces. Cable tension and sag apply horizontal forces to the cable.

Uplift forces are possible between uneven elevations or mechanical impact on conductor i.e. falling branch. Vertical pulls were performed using standard vise-top insulators with Nylon, Aluminum, and Composite inserts to determine the ultimate breaking point of the insulator.

Test Method – Vertical Pull

Each test conductor was placed onto the top platform of the vise top and tightened, (bottom bolt first), until the eyelets broke off at approximately 85 in-lbs of torque.

The point of contact between the conductor and insulator was in the linear direction and the length of the insert.

The test cable was 12” long and only secured in the grip of the insulator. The remaining portion was unsecured in a steel channel.

Crosshead rate of 0.5-inch/minute was applied. Each sample was pulled to the point of failure.

Test Equipment and Setup

The force was applied using a Test Resources materials testing machine, equipped with an Interface strain gage load cell for capturing applied load data. The mechanical test system is calibrated on a 18-month cycle.

Hendrix Molded Products 116 Route 101A Amherst, NH 03031
Tel: 603-673-2040 Fax: 603-673-1497 E-mail: molded@hendrix-wc.com Website: www.HendrixHPI.com
A Marmon Wire & Cable / Berkshire Hathaway Company

Results

HPI 35VTP-01 with 1.230” OD Hendrix Covered Cable

Peak = 1667 lbs

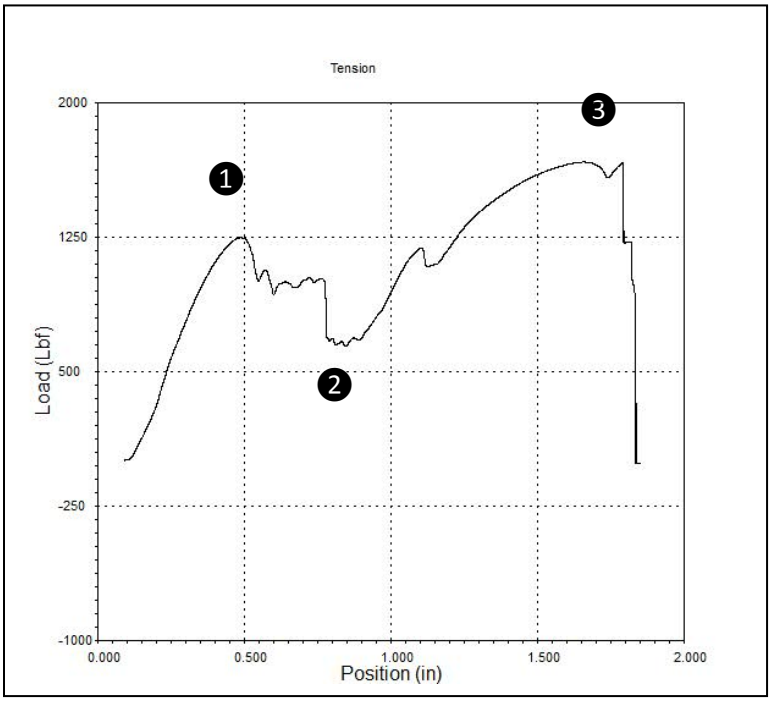
The applied force is displayed on a graphical interface and recorded for each sample.

A representative plot is shown at right.

Marker #1 indicates the point at which the conductor pulls out of the grips.

Marker #2 indicates the point where the conductor contacts the keepers.

Marker #3 indicates termination of the applied force and both the bottom and top bolts broke.



Start of Test

Completion of Test

Engineering Report

HPI 25VTM-02 with .750” OD compact aluminum conductor

Peak = 701 lbs – stopped due to bent conductor

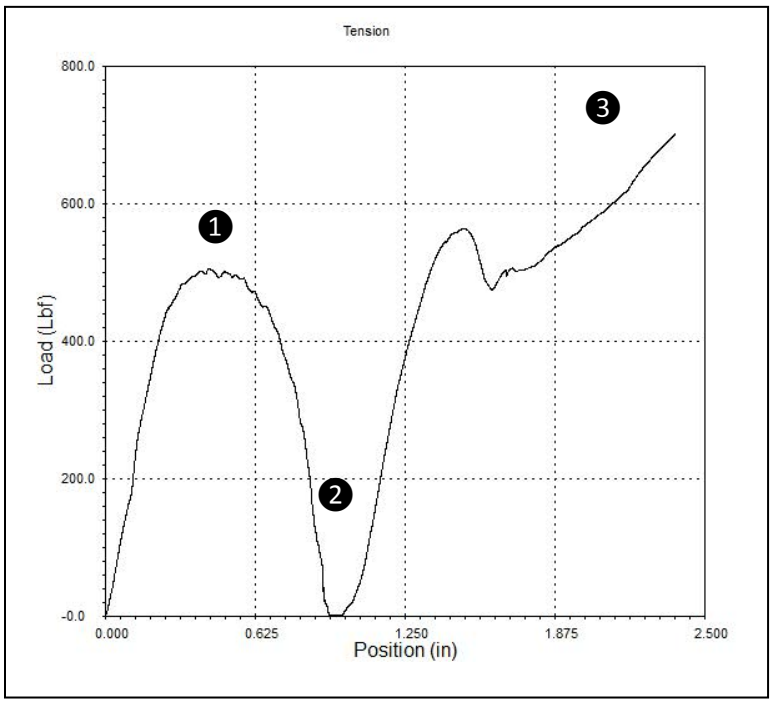
The applied force is displayed on a graphical interface and recorded for each sample.

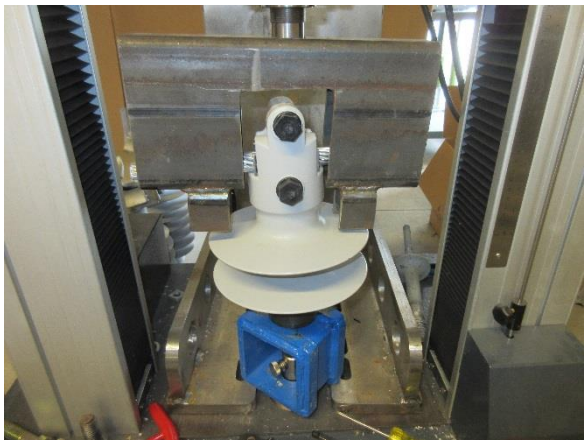
A representative plot is shown at right.

Marker #1 indicates the point at which the conductor pulls out of the grips.

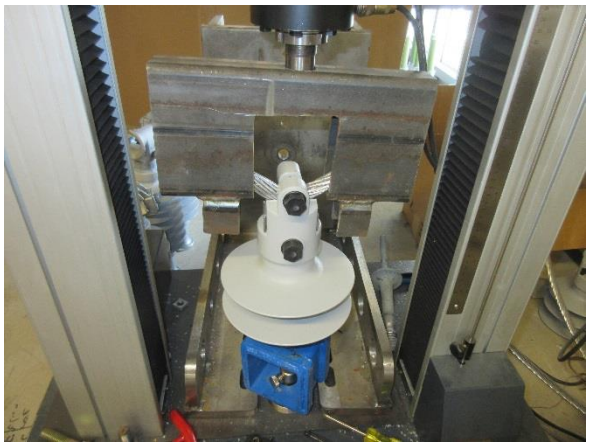
Marker #2 indicates the point where the conductor contacts the keepers.

Marker #3 indicates the point where the conductor severely bends and the test is stopped. The insulator did not fail.





Start of Test



Completion of Test

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Engineering Report

HPI 35VTC-02 with .750” OD compact aluminum conductor

Peak = 677 lbs

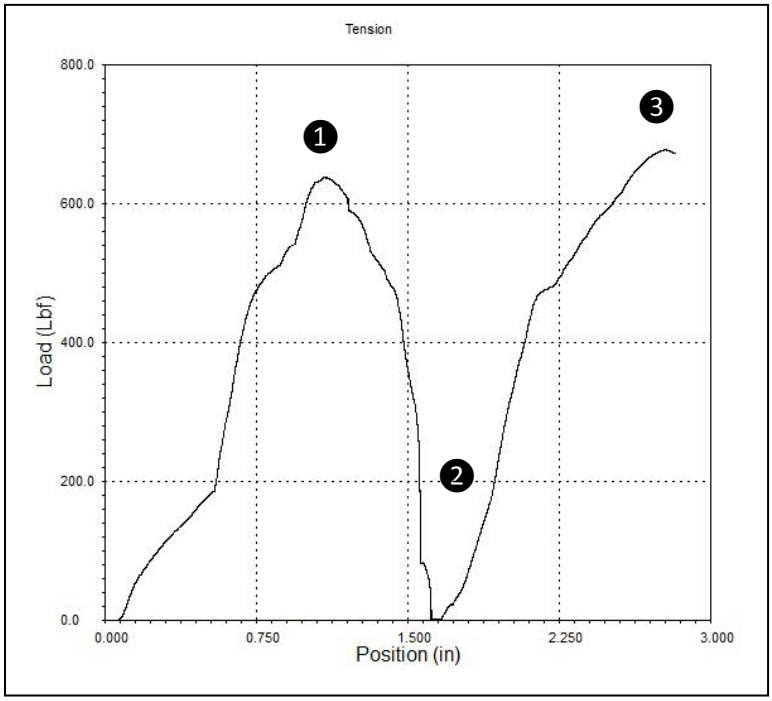
The applied force is displayed on a graphical interface and recorded for each sample.

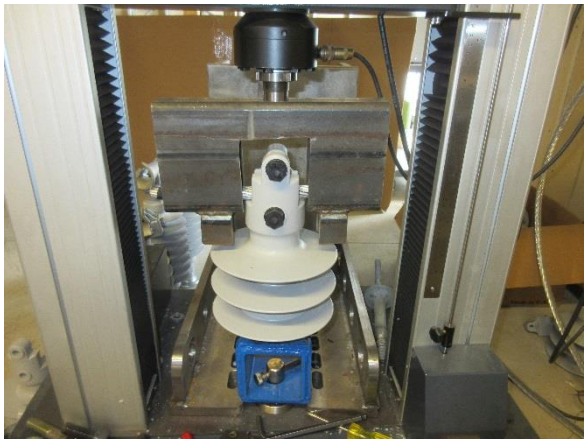
A representative plot is shown at right.

Marker #1 indicates the point at which the conductor pulls out of the grips.

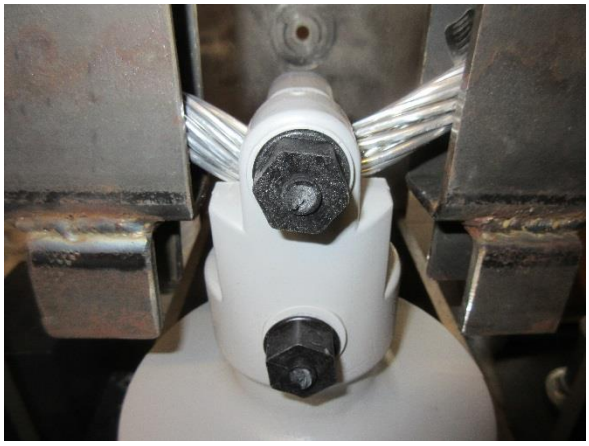
Marker #2 indicates the point where the conductor contacts the keepers.

Marker #3 indicates the point where the test was stopped due to the bent conductor. The insulator did not fail.





Start of Test



Completion of Test

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HPI 25VTM-01 with .615” OD steel rod

Peak = 1510 lbs

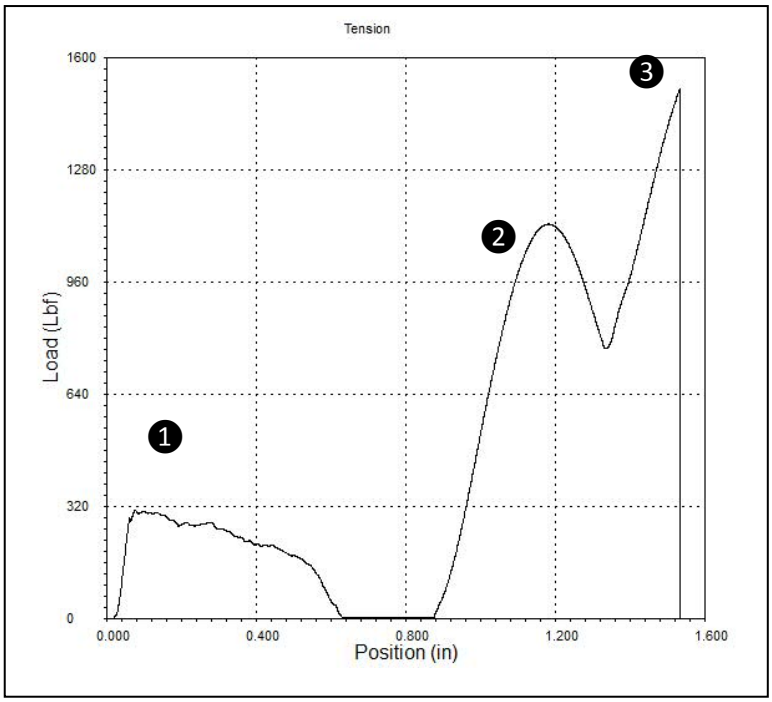
The applied force is displayed on a graphical interface and recorded for each sample.

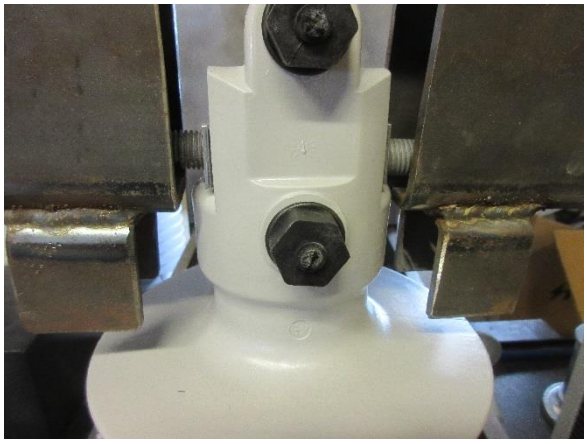
A representative plot is shown at right.

Marker #1 indicates the point at which the conductor pulls out of the grips.

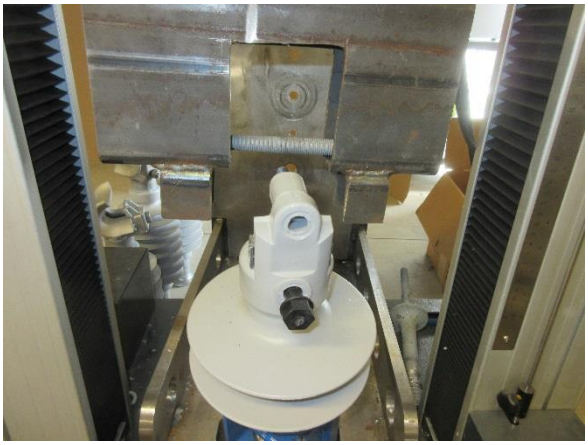
Marker #2 indicates the point where the conductor contacts the keepers the knee is where it contacts the bolt.

Marker #3 indicates the point where the top bolt breaks.





Start of Test



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HPI 35VTP-01 with 1.0” OD steel rod

Peak = 1740 lbs

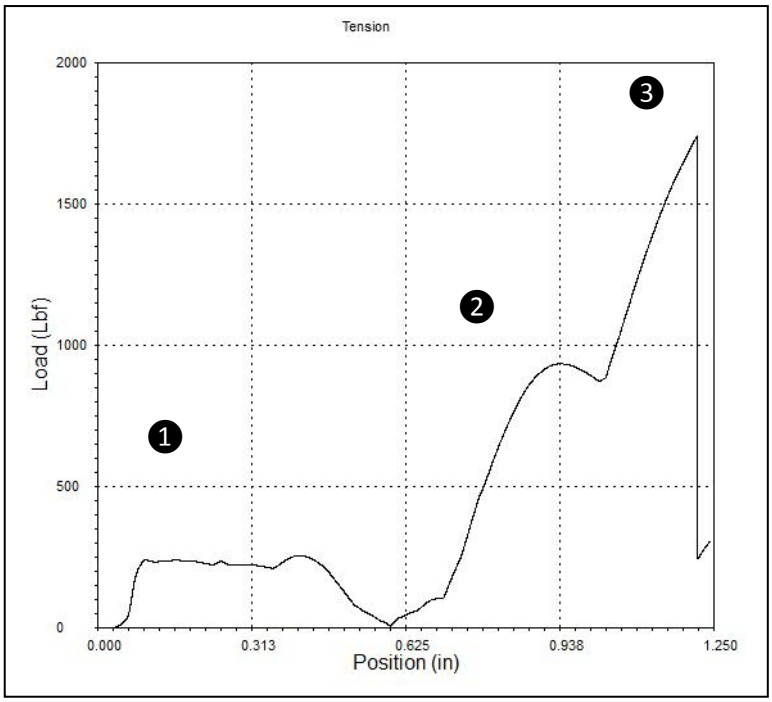
The applied force is displayed on a graphical interface and recorded for each sample.

A representative plot is shown at right.

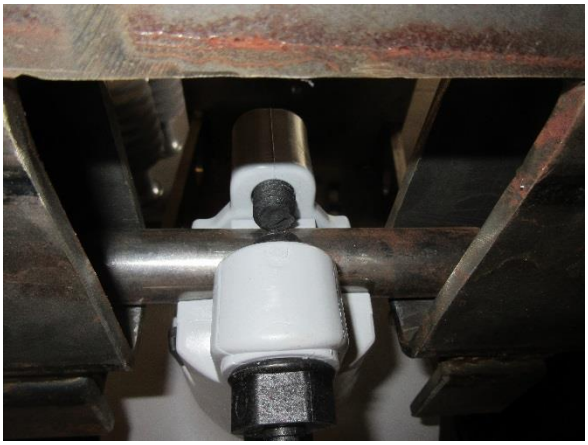
Marker #1 indicates the point at which the conductor pulls out of the grips.

Marker #2 indicates the point where the conductor contacts the keepers the knee is where it contacts the bolt.

Marker #3 indicates the point where the top bolt breaks.



Start of Test



Completion of Test

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Engineering Report

Summary

Test #	Insulator	Conductor	Force (lbs)	Failure
1	HPI-35VTP	1.230”OD Al	1667	Bolt broke
2	HPI-25VTM	.750”OD Al	701	Cond bent
3	HPI-35VTC	.750”OD Al	677	Cond bent
4	HPI-25VTM	.615”OD steel rod	1510	Bolt broke
5	HPI-35VTP	1.0”OD steel rod	1740	Bolt broke

Discussion

In a typical application, the conductors would be secured and not allowed to bend. Tests # 2 & 3 resulted in lower numbers because the test was stopped due to the bent conductor and before the insulator reached the point of failure.

Test # 1 represents a typical point of failure for a vertical pull – 1667 lbs, bolt broke.

Tests # 4 & 5 eliminated any bend from the conductor. The different diameters changed the closed jaw position but verify the validity of test value in Test #1.

Note: Regardless of the size and type of the bare conductor, voltage class, or insert type, the ultimate point of failure is the same and the bolt breaks.

Testing by:

Gary Grenier

March 7th, 2019

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